AD-A118 281 ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY ABERDEEN PROV--ETC F/G 9/5
WATER ENTRY INTO THE MX-6707/VRC ANTENNA MATCHING UNIT-BASE.(U)
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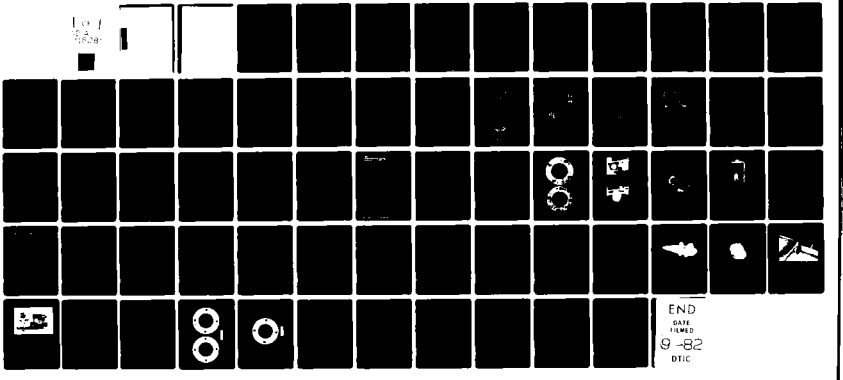

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The MX-6707/VRC Antenna Matching Unit-Base fails at a high rate because water enters through cracks in the Lexan material. The cracks are caused by personnel applying excessive torque to the mounting hexbolts. It is suspected that water enters the matching unit when the vehicle with the matching unit mounted in it is washed using a high pressure hose. Subsequent rust and corrosion of the internal electronics is so severe that sixty percent of the matching units are rejected at the repair depot. Some damage is also caused during field exercises by the extended antenna hitting trees and brush and transmitting stress to

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the MX-6707.

Four modifications were introduced between 1975 and 1977 to resolve the water entry problem, but they were not made on fielded matching units. Modified units are working satisfactorily as indicated from AMSAA Field Liaison trip reports, a field survey conducted by SGO CECOM Representatives, and limited tests conducted at the Aberdeen Proving Ground by the Materiel Testing Directorate (MTD). The MTD tests did not address aging or environmental factors.

Testing by MTD showed that when a good flat gasket and preformed packing were used, water did not enter the matching unit base. Employing a steel reinforced ring and an anticapillary gasket also aided in preventing leakage. Elimination of the inserts in the mounting flange, heeding the maximum torque specified for the hexbolts, and checking for any moisture or water via the drain screw all help reduce water entry and water settling. Permanent expansion of the anticapillary gasket that resulted from exposure to elevated temperature (160 degrees Fahrenheit), indicates a need to evaluate the resiliency and thermal distortion properties of this type of rubber gasket and the silicone compound used to coat it.

The effectiveness and cost effectiveness of a chemical process for removing rust and corrosion from the components of the MX-6707 during Depot maintenance is being evaluated by personnel at Fort McPherson and CECOM. This process should be evaluated against the ultrasonic solution method both for effectiveness and cost.

CONTENTS

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WATER ENTRY INTO THE MX-6707/VRC ANTENNA MATCHING UNIT-BASE

1. INTRODUCTION

1.1 Objective.

The objective of the AMSAA investigation of water entry into the MX-6707/VRC Antenna Matching Unit-Base for the AN/VRC-12 Radio Set Series, is to seek cause-and-effect relationships that can lead to corrective actions to prevent a reoccurrence of this problem and other problems (e.g., plastic cover breakage, electrical shorts, drive motor oscillations, and spring assembly breakage).

1.2 Background.

Field users are experiencing a high failure rate with the matching unit (see Appendix A). The problems have been verified through AMSAA Field Liaison visits to military organizations. In two years, about 400 MX-6707 units were sent to the Tobyhanna Army Depot (TOAD) for repair. Of these, 240 units, or sixty percent, were rejected as nonrepairable due largely to excessive corrosion and rust. The Communications and Electronics Command (CECOM), Ft. Monmouth, New Jersey procures about 30,000 matching units per year for new and replacement use (see Appendix B for various contracts).

1.3 Approach.

The multi-step approach to determine the cause of the moisture problem was to:

(a) Review damaged base-units to determine causes of failure.

(b) Pressurize the base-units with air (3-6 pounds per square inch gauge (psig)) and immerse them in water, or a dye solution, to determine the location of any leaks.

(c) Determine the operating temperature of the base-unit that houses the electronic components. Thermocouples were attached to the outer skin and also internally, and a radio transmission test was conducted with the MX-6707 and matching antenna placed in an environmental chamber.

1.4 Description of the MX-6707/VRC.

The MX-6707 is the base for the vehicular AS-1729/VRC Antenna assembly. The AS-1729 is an omidirectional, vertically polarized, whip, center-fed antenna having bottom (AS-1730/VRC) and top (AT-1095/VRC) elements (see Figure C1, Appendix C). The cover for the internal components of the MX-6707 separates into two pieces, a Lexan (plastic) upper case and an aluminum lower case (see Figure C2, Appendix C). Lexan, a polycarbonate resin with high impact mechanical properties, is a trademark of the General Electric Company.

Inside the lower case of the MX-6707 is a helical choke, nine groups of shunt reactance components (mixtures of seven capacitors and ten inductors), a relay, a rotary latching solenoid, and a rotary switch (see Figures C3 and C4, Appendix C). The switch is driven by the solenoid, which functions with the relay to connect the appropriate group of shunt reactance components to the base of the whip portion of the AS-1729. On the bottom of the lower case, there is a tuning switch that enables the manual selection of the tuning components for ten sub-bands covering the very high frequency (VHF) range from 30-to-76 megahertz (MHz). The radio frequency (RF) output is fed through the helical choke to the ten foot, center-fed, whip antenna. Its impedance matches the 50-ohm transmitter output impedance and the receiver input impedance over the entire frequency range of the equipment. The upper case (Lexan) contains: (1) helical choke (matching balun) and its two leads, (2) the RF cable to the whip antenna, and (3) a single lead to the receiver-transmitter in the lower case.

1.5 Modifications and Improvements.

Four design changes were incorporated in the MX-6707 in 1975 to prevent water leakage. These are a small rubber gasket, an anticapillary gasket, a steel reinforcing ring, and an adhesive.

1.5.1 RF Connector Rubber Gasket. The initial contract for adding the small rubber gasket to new units was DAAB07-75-C-0318 and all succeeding contracts (see Appendix D for list of contracts and quantities of antennas involved). To retrofit fielded units requires Depot installation of the gasket on the RF connector pin (located inside the main spring mount assembly) that fits into a receptacle at the top of the plastic matching unit.

1.5.2 Anticapillary Gasket. The next modification required the addition of a rubber anti-capillary gasket with raised ring so it will fit snugly into the groove of the lower case. This gasket prevents water entry due to capillary action. The anti-capillary gasket replaces a flat gasket and preformed packing (i.e., O-ring, provided for the groove of the lower case). Anticapillary gaskets were provided starting with contract DAAB-7-75-C-0138.

1.5.3 Steel Reinforcing Ring. Another modification added a steel reinforcing ring. The ring is provided for external installation on the flange of the MX-6707. It acts as a large washer to absorb the stress of tightening the four hexbolts on the Lexan body and as a splash shield to prevent the direct entry of water sprayed under high pressure hosing. The ring is provided with new equipment on contract DAAB07-75-C-0157 and all succeeding contracts. This modification made possible the elimination of the metal inserts in the four counterbored mounting holes of the flange.

1.5.4 Adhesive. On the top section of the matching unit, there is a receptacle for the lead-in (RF Cable assembly) from the antenna, and a groove which is fitted with preformed packing. It was suspected that water entered through the antenna lead-in spring mount assembly. Consequently, the modifications of 1977 (e.g., contract DAAB07-77-C-0517 and all succeeding contracts) required that an adhesive sealant be applied to the joint of this upper portion and the rest of the plastic matching unit-base. In addition to the adhesive being used as a bonder and sealant against water, it also

distributes stress along the entire joint rather than concentrating it at a single point.

1.5.5 Precautions. A thin film of silicone insulating compound (NSN 6850-00-880-7616) is applied to the preformed packing and small rubber gasket (item AE3-MP44MP53) which slips into the pin contact of the cable assembly, AFTER the surface is cleaned. It is important NOT to let the insulating compound touch electrical contacts. A plastic dust cover and retainer ring are provided for protecting the MX-6707 contact and keeping it dry (see Figure 1, Appendix E).

TM 11-5985-262-15 (change 6, page 6-8) states that both sides of the anticapillary gasket are to be lubricated with silicone compound. It is important that the proper silicone compound be used, as will be noted later in this report under Test Results.

TM 11-5820-401-12 (August 1977, change 1, page 2-5) cautions installers not to overtighten the hexbolts beyond a snug fit (100 inch-pounds, maximum) so as not to damage the plastic body or the threads. In many matching units examined in the field, this caution evidently was not heeded.

PS Magazine (Issue 346, Sep 81, pages 46-47) warns users not to scratch the contacts and insulator of the MX-6707. These scratches stem from the screws that hold the horseshoe contact in place in the AS-1730 antenna element. What precipitates the problem is that the baseplate becomes loose causing the screws, which are inserted into the threaded ring, to scrape the contacts on the MX-6707 before the AS-1730 fully seats on the matching unit (see PS Magazine, Issue 339, Feb 1981, page 47). The metal coating that comes off allows high reflected RF power that greatly affects the radio's receiver-transmitter. The article in Issue 346 of PS Magazine describes methods to prevent such scratches through the proper seating of the antenna.

Another PS Magazine article (Issue 339, Feb 1981, page 45) discusses the proper tie-down of the whip antenna on the M151 vehicle enabling easing of the strain on the MX-6707 matching unit's spring. Although the article advises against putting the AT-1095 antenna element under the tie-down clamp thereby enabling the antenna whip to pop free if it hits a tree branch, CECOM Supply letter, dated 31 December 1981 (page 12), contravenes this. Purely from a safety viewpoint, to keep the antenna from becoming free and thereby possibly striking electric railway power conductors causing a severe hazard to the vehicle's occupants, the article advises users to secure the whip antenna beneath the vehicle tie-down clamp. This new procedure will be reflected in updates of TM 5820-401-10-1 and TM 5820-401-10-2.

1.5.6 Drain Screw. There is a drain screw (#10-32) at the bottom of the matching unit which is to be removed after rain or after washing the vehicle. One problem is that the water may not drain out if the screw is removed. Surface tension, the air tight seals, and the lack of a positive pressure prevent a free (gravity) flow. Insertion of a small hollow tube into the hole will alleviate this problem. Thus, care must be exercised to ascertain that any collected water has drained and that the unit's interior is dry (ref: PS Magazine, Issue 331, June 1980, page 46).

1.5.7 Installation of Modifications. The improvements discussed have been incorporated into new procurements, but it has been left to the discretion of the user to retrofit fielded systems. The metal ring is installable by the organization, the improved gasket is a General Support (GS) installation, and the top seal, small rubber gasket and preformed packing can only be applied during Depot rebuild.

Since 1 February 1981, the MX-6707 has been changed back from Class 2 reportable to Class 9G non-reportable for repair parts classification.

2. TEST RESULTS

2.1 Field Experience.

In order for the responsible Commodity Command to initiate a Product Improvement Program (PIP) or other actions, they need data that indicate both the magnitude and seriousness of the problem, including the readiness posture. CECOM provided AMSAA a copy of "Field Survey of AS-1729/VRC", dated 3 June 1980 (refer to Appendix E), which shows that forty-six percent of the antenna units in the field exist without the improved gasket and reinforcing ring. PIP 1-81-07-0209 was approved in December 1980 to retrofit existing matching units. Revision of modification application plans, development of Statement of Work and field coordination documents are in process, scheduled for completion in the second quarter of FY82, and may be accelerated if application funds become available to CECOM.

AMSAA provided CECOM (see letter and inclosures dated 13 February 1980) experience from field trips to Ft. Polk, LA (July 1979), and Ft. Hood, TX (December 1979). See Appendix F for this notification. A hand-held pressure unit was devised to pressurize, at six psig, the MX-6707 and any signs of leakage were noted. Results of this on-site testing did not reveal any water in the units. Other information was obtained that indicated over a four-month period (January to May 1979), eleven out of 120 matching units were sent to maintenance with varying problems. The hand-held pressure unit was used on twenty MX-6707 matching units, fourteen with the reinforced ring, and six without. Results of the test showed that three of the units without rings contained water including one that had rust.

During a field trip (16-27 July 1979) by AMSAA personnel to the C&E Maintenance Group (DIO, Ft. Polk), problems were noted with a number of MX-6707 units. An old, used MX-6707, that had signs of water leakage in the field, was given both a vacuum and a pressure test. Both tests indicated leakage which resulted through obvious cracks outside and around the mounting holes. The mounting holes had inserts in them that were pressed down against the O-ring (see Appendix G, Figure G1) probably due to excessive torque applied to the mounting hexbolts. This particular matching unit was SN 05389C, manufactured by Hy-Gain on contract DAAB05-73-C-0002. It contained the flat gasket and preformed packing O-ring and had no metal ring. The unit was brought back to Aberdeen Proving Ground, MD. Further pressurized tests were run including evacuating the unit to fifteen inches mercury, and it leaked. It was later pressurized to 6-1/2 psig, immersed in water, and bubbles appeared indicating leaks around all four mounting holes. See the various pictures showing the problems (Appendix G, Figures G2-G4). Figure G4 shows compression

of the O-ring around the mounting holes when the hexbolts are over-torqued and it also shows a corroded network assembly. The rotary solenoid would not turn enough to advance the frequency changing gear.

2.2 MTD Tests.

2.2.1 Preliminary. The Engineering Test Branch, MTD, Aberdeen Proving Ground, Maryland was tasked to determine the cause of the water and moisture problems in the MX-6707/VRC Antenna Matching Unit-Base. Two damaged MX-6707 matching units (SN 40598A and SN 05983C), returned from field operations were examined. One new matching unit (SN 20211H) was also used in the test and evaluation program. The MTD report is included as Report #2, Appendix H.

The two used units did not have the improvements (e.g., anticapillary gasket and metal ring), while the new unit did. The two used units had cracks in the mounting flange around each of the four mounting holes. The stepping motor, switch housing, and all the ferrous components within the bottom section of the matching unit were rusted and corroded. It was obvious that substantial quantities of water had entered and remained in both these units. The new modified version was tested to determine its sealing ability using both the old, flat gasket and preformed packing (see Appendix I, Figure I1) and the new, anticapillary gasket (see Appendix I, Figure I2) and metal cover. The drain screw was removed and replaced by a threaded adapter for use in pressurizing the inside of the matching unit.

2.2.2 Water and Dye Submersion. No leakage was observed when the new matching unit, pressurized internally at 10.5 psig, was submerged in room temperature water for fifteen minutes.

Tests were next conducted on the matching unit which was conditioned at an elevated temperature (160°F), then immersed in a dye solution of sodium fluorescein and allowed to soak for two hours. There were some droplets of the dye in the gasket-to-Lexan surface between the second ridged area and the large O-ring seal and grooved portion of the anticapillary gasket. The water did not penetrate to the interior cavity where the electronic parts are housed. It is concluded that the improved gasket, when properly installed in an undamaged MX-6707, will prevent moisture from entering the interior network.

After the elevated temperature test, the gaskets were examined. The anticapillary gasket had permanently stretched, increasing its diameter by 3/8-inch (see Appendix I, Figure I3). The cause is believed to be due to the elevated temperature and flange compression of the gasket. If the anticapillary gasket, between the top and bottom sections of the matching unit, is sticking out around the edges, it may be crushed and thus not doing its job; therefore, it should be changed. In talks with personnel at CORADCOM (Ft. Monmouth, NJ), it was learned that the gaskets, manufactured by Hy-Gain (Div. of Telex Communications, Inc.), had a thin coat of silicone spread on them. It was stated that the type of silicone grease causes the rubber gasket to expand under heat. At first, it was suggested that the gasket be made of neoprene rubber instead of silicone rubber. Neoprene has good resistance to weathering and oil. Its aging properties are superior to those of natural rubber and it has good resistance to heat.[2] It was later noted that neoprene hardens

at cold temperatures and presents problems. Too much silicone grease put on a gasket that is placed in a hot temperature environment, causes an outward force that creates a round, or bulging, effect. Luckily, a crosswise split does not develop since it would allow water entry.

These tests were repeated with the old flat gasket (NSN 5330-00-078-4184) and preformed packing (NSN 5330-00-091-194) installed in the new matching unit. The matching unit was similarly conditioned at 160°F and then immersed in the dye solution and allowed to soak for two hours. Several small droplets of dye solution were found in the seal and groove area. It was again concluded that when a good, flat gasket and preformed packing are installed in an undamaged MX-6707, water will be prevented from entering the interior network area. Under aging and repeated tests, however, this arrangement might leak.

2.2.3 High Pressure Water Stream. The MX-6707 was conditioned at 160°F and then subjected to a high pressure water stream from a hose against the sides for six minutes while the matching unit was rotated ninety degrees each one-hand-a-half minutes. In both cases, using anticapillary gasket and then the flat gasket, no water penetration was evident at the gasket or in the interior of the matching unit.

2.2.4 Radio Transmission-Induced Temperature Change. The MX-6707 was instrumented with two external and two internal thermocouples. The next test was to determine how much the external and internal temperature rises when the matching unit, mounted on a tracked vehicle, was subjected to continuous radio transmission for six hours. There were rises in temperature up to 20°F internal and 14°F on the surface (see Figure B5 in MTD Report #2, Appendix H).

Originally, it was suspected that the rise in internal temperature resulted from continuous radio transmission and the heat generated by the electronic components and environmental conditions would cause some damage in normal on-off use. These test results seem to belie that suspicion.

3. REPAIR AND REWORK PROCEDURES

3.1 25th Division Chemical Process.

CECOM engineers are evaluating the effectiveness and cost of a 25th Infantry Division chemical process for removing rust and corrosion from the components of the MX-6707. If successful, the repair procedures will be incorporated in the appropriate TM and Depot Maintenance Work Requirement (DMWR). The procedure will be authorized only for use at Depot and Specialized Repair Activities (SRA) maintenance levels.

The chemical process (see Appendix J) is intended to remove oxidized material accumulated by moisture and water. The process includes subjecting the housing and internal parts to a waterborne abrasive called Liquasheen, cleaning in a mild chemical bath (TURCO Wol and SANICO 600), washing, sandblasting, and then placing the unit in a heat chamber for drying. The process takes about two hours. In the course of the operation, it is important not to touch the coils. Vector impedance electrical tests were also conducted using

the Smith Chart for proper frequency alignment. These tests were equivalent to those performed during Depot maintenance to insure proper alignment and frequency outputs for the ten frequency bands of the MX-6707. CECOM states that the labor cost for the chemical cleaning and electrical test is about $10 per matching unit.

The 25th Division chemical process is more hazardous to the operator, does not dry fast, and leaves a film on the unit, which requires an extra bath using RCT95 Safety Solvent. This process also causes flaking of the Q-dope used to lock the coil. It dissolves the Glyptol and Loctite off the tuning slugs and takes off some of the stencilling from the data plates. Also, the stepper switch assembly must be replaced because the chemicals cause the switch to "freeze-up".

As noted in Field Service Operational Activity Report (FSOAR) No. 4-80 and 5-80 (12 Jan 80), visual inspection of the treated units indicated that cleaning and removal of corrosion was accomplished satisfactorily. Next, the units were examined using X-ray and a Scanning Beam Microscope for any etching and deterioration of components. Nothing significant was noted. Preliminary information indicates that the chemical process is effective on selective units.

3.2 Marine Corps Maintenance Procedure.

The Naval Air Development Center (Warminster, PA) developed new maintenance procedures, "Recommendations for New/Improved Maintenance Technology - Marine Corps Equipment," dated 4 November 1976. For corrosion in the MX-6707 due to moisture or water, they recommend the following: "Apply MIL-C-81309 and remove corrosion by abrading surfaces with MIL-A-9962 abrasive mat. Wipe area with clean cloth dampened with solvent (TT-T-291, P.D. 680). Allow to air dry. Reapply MIL-C-81309."

3.3 Tobyhanna Army Depot Process.

TOAD personnel place corroded MX-6707 units in an ultrasonic bath that contains Sonic Solvent #113 (manufactured by London Chemical Co., Bensenville, IL), a safe chemical having a high flash point. Upon removal, the units are placed in an oven for drying. The process takes about fifteen minutes per unit and costs less than two dollars per unit. After drying, the units have no dirt, corrosion or film on them. After drying, replacement of parts are made where required and the housing is sandblasted. The MX-6707 unit must then be aligned according to CECOM Depot Maintenance Work Requirement (DMWR) 11-5985-262 (October 1979).

4. CONCLUSIONS

The investigation performed by AMSAA and tests performed by MTD have shown that the modifications made to the MX-6707 are eliminating water entry and its damaging effects. It was also demonstrated that a new flat gasket and preformed packing (O-ring) will also prevent water entry. Water entry results when excessive torque is applied to the mounting bolts, which cause cracks and torn gaskets.

When the gasket was coated with a thin film of silicone compound, subjected to "hot" conditioning, and then immersed in the dye solution for two hours, the gasket permanently stretched, increasing in diameter by 3/8-inch. It is suggested that alternate gasket materials be evaluated for greater resiliency and resistance to thermal distortion and that the properties of the silicone compound be examined so that the correct type of compound can be applied.

An important factor in the reduction and elimination of water entry into the MX-6707 resulted from eliminating the steel inserts in the four mounting holes on the flange of the bottom case and the introduction of a steel reinforcing ring. When over-torqued (which seems to occur frequently in the field), the inserts crush the rubber gasket thereby likely creating leakage problems. Another important factor was the addition of a one-piece anticapillary flange gasket with a raised ring that prevents water entry due to capillary action.

Field trips by AMSAA personnel have not surfaced failures due to water leakage in MX-6707 units that have incorporated the improvements noted above. Also, in the "Field Services Operational Activity Report (FSOAR) 6-80E", dated 23 June 1980, it was reported that a field survey conducted by SGO CECOM Representatives on the improved MX-6707 units did not show any failures from water damage. They did find some component failures, such as power/RF connectors, frequency selecting relays, and tuning circuits, but none of these failures were caused by water entry.

The maintenance and rework procedures conducted by Tobyhanna Depot seem to be effective and less harmful, both to personnel and to the matching unit, than the CECOM developed procedures. In addition, they are more cost-effective than those proposed by CECOM.

REFERENCES

1. TM 11-5820-401-12/WAVELEX 0967-432-3010 (Aug 1972) with changes. Operator's and Organizational Maintenance Manual Including Repair Parts and Special Tools Lists - Radio Sets AN/VRC-12, AN/VRC-43, AN/VRC-44, AN/VRC-45, AN/VRC-46, AN/VRC-47, AN/VRC-48, AN/VRC-49, AN/VRC-54, and AN/VRC-55; Mounting MT-1029/VRC and Mounting MT-1898/VRC Antenna AT-912/VRC; Control, Frequency Selector C-2742/VRC and Control, Radio Set C-2299/VRC.

2. Encyclopedia of Polymer Science and Technology - Plastics, Resins, Rubbers, Fibers, Vol 12, 1970, pp 327-330.

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APPENDIX A

VRC-12 RADIO PROBLEM AREAS

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APPENDIX A - VRC-12 PROBLEM AREAS

SYSTEM: MATCHING UNIT, MX-6707 - PART OF RADIO SET, AN/VRC-12 SERIES

PROBLEM	ACTION REQUIRED
a. Water enters and corrodes the internal parts: *7905-057 7902-038 7603-013 7704-009 7904-051 8102-155 7601-009 7602-025 b. Water does not come out when drain screw is removed: 7902-038 7905-057 c. Case develops cracks: 7603-013 7904-051 7904-038 d. Spring cracks: or is damaged: 7705-029 7605-013 7806-031 e. Separate Causes (other than water entry and cracks) 7704-009 7701-010 8102-154 7701-011 7601-008 7807-116 7T01-014 7802-017 8003-026 *AMSAA Field Problem Number	a. At the organizations survey the matching unit to find: (1) the contract number (2) the serial number (3) is the steel ring used? (4) does water drain out when screw is removed? (5) if no water, does bottom of screw look wet, or does the screw hole look wet? (6) are there visable cracks in the case? b. At the GS level: (1) have anticapillary gaskets been installed in units mfg before contract DAAB07-75-C-0138? (2) what is the total no. of units received during same period? (3) how many of these units are unrepairable because of corrosion? (4) of these leaking, unrepairable units, how many had (a) cracks (b) no cracks, but anticapillary gaskets? (c) no cracks, but flat gaskets? (5) have they noticed any change in the rate of corroded pieces due to units using steel rings (approx. 1977) or anti-capillary gasket (approx. 1975)?

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APPENDIX B

PROCUREMENTS OF ANTENNAS AS-1729/VRC

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APPENDIX B

PROCUREMENT OF ANTENNA, AS-1729/VRC (INCLUDING MODIFICATIONS)
NOTE: PRIOR TO 1972 - PEMA FUNDS USED (STOCK ITEMS)

YEAR	CONTRACT	MANUFACTURER	NUMBER
1964	FR-36-039-X-5-00586	AZCO	2,000
1964	FR-36-039-V-6-31928	AZCO	43,856
1967	DAAB05-67-C-0174	AZCO	16,018
1968	DAAB05-68-C-0009	LaPointe Industries, Inc.	44,018
1970	DAAB05-70-C-4405	LaPointe Industries, Inc.	9,514
1972	DAAB05-72-C-5205 (Flat gasket and Preformed Packing Provided)	Hy-Gain Electronics Div.	14,572
1973	DAAB05-73-C-0002 (Flat Gasket and Preformed Packing Provided)	Hy-Gain Electronics Div.	12,838
1973	DAAB05-73-C-0010 (Flat Gasket and Preformed Packing Provided)	Hy-Gain Electronics Div.	8,068
		SUBTOTAL 1	150,884
1975	DAAB07-75-C-0138 *(7/16" Rubber Gasket, PN MP44MP53 Procured on this & Succeeding Contracts) *(Anticapillary Gasket, DWG #SC-C-877431 procured on this & Succeeding Contracts)	Hy-Gain Electronics Div.	16,111
1976	DAAB07-76-C-0085	LaPointe Industries, Inc.	15,000
1976	DAAB07-76-C-0014	Hy-Gain Electronics Div.	16,841
		SUBTOTAL 2	47,952
1977	DAAB07-77-C-0157 *(Reinforcing Ring & Dust Covers Installed on this & Succeeding Contracts)	Hy-Gain Electronics Div.	33,682
1978	DAAB05-78-C-0154 (Philadelphia Procurement Office)	Hy-Gain Electronics Div.	21,382 8,408
		SUBTOTAL 3	63,472
		SUBTOTAL	262,308
1978	DAAB07-78-C-0198 (delivery in 1st Qtr 81)	ROIS Manufacturing	14,000
1979	DAAB07-79-C-0083 (not delivered - on order)	Hy-Gain Electronics Div. " (option, added on)	19,000 19,000

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APPENDIX C

ANTENNA COMPONENTS AS-1729/VRC

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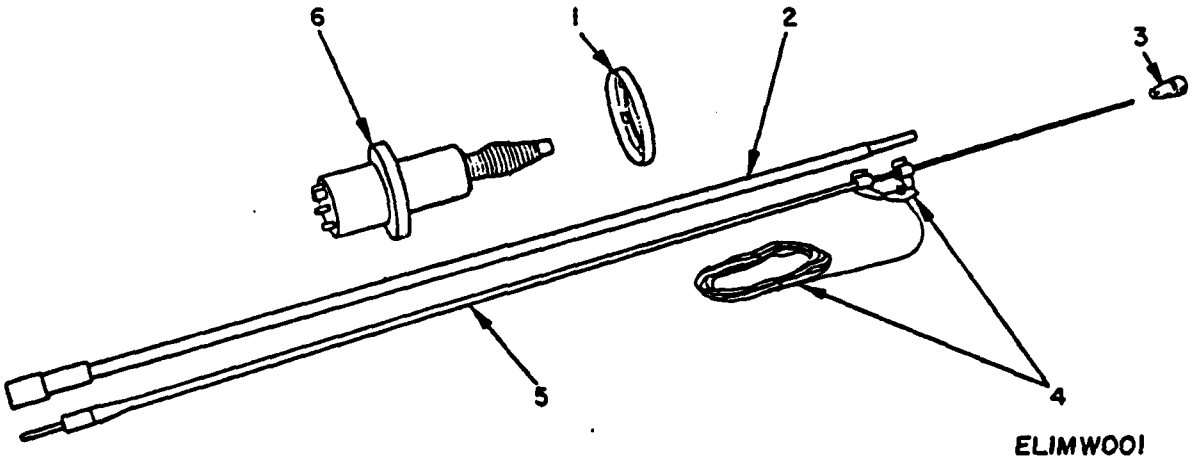


Figure 1. Antenna AS-1729/VRC. ($139.00)

SECTION II REPAIR PARTS LIST

(1) ILLUSTRATION (A) FIG NO.	(1) ILLUSTRATION (B) ITEM NO.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION USABLE ON CODE	(7) UNIT OF MEAS	(8) QTY INC IN UNIT
						GROUP: 00 ANTENNA AS-1729/VRC		
1	1	PAOZZ	5985-01-012-5425	8CC8TT489	80063	RING, STEEL, REINFORCING ($1.19)	EA	1
1	2	PAOZZ	5985-00-985-9022	AS1730VRC	80058	ANTENNA ELEMENT, FIBER ($26.67)	EA	1
1	3	PAOZZ	5920-00-437-2353	8CC446180	80063	CAP, ANTENNA TIP ($0.38)	EA	1
1	4	PAOZZ	5820-00-906-6416	8CC20BT67	80063	ANTENNA, TIP-COMB KIT ($1.40)	EA	1
1	5	PAOZZ	5820-00-856-2720	AT1095VRC	80058	ANTENNA ELEMENT ($9.87)	EA	1
1	6	PAOZZ	5820-00-906-1115	MX670TVRC	80058	MATCHING UNIT BASE, ANTENNA ($127.00)	EA	1

TOTAL $166.51

FIGURE C1 - ANTENNA STRUCTURE

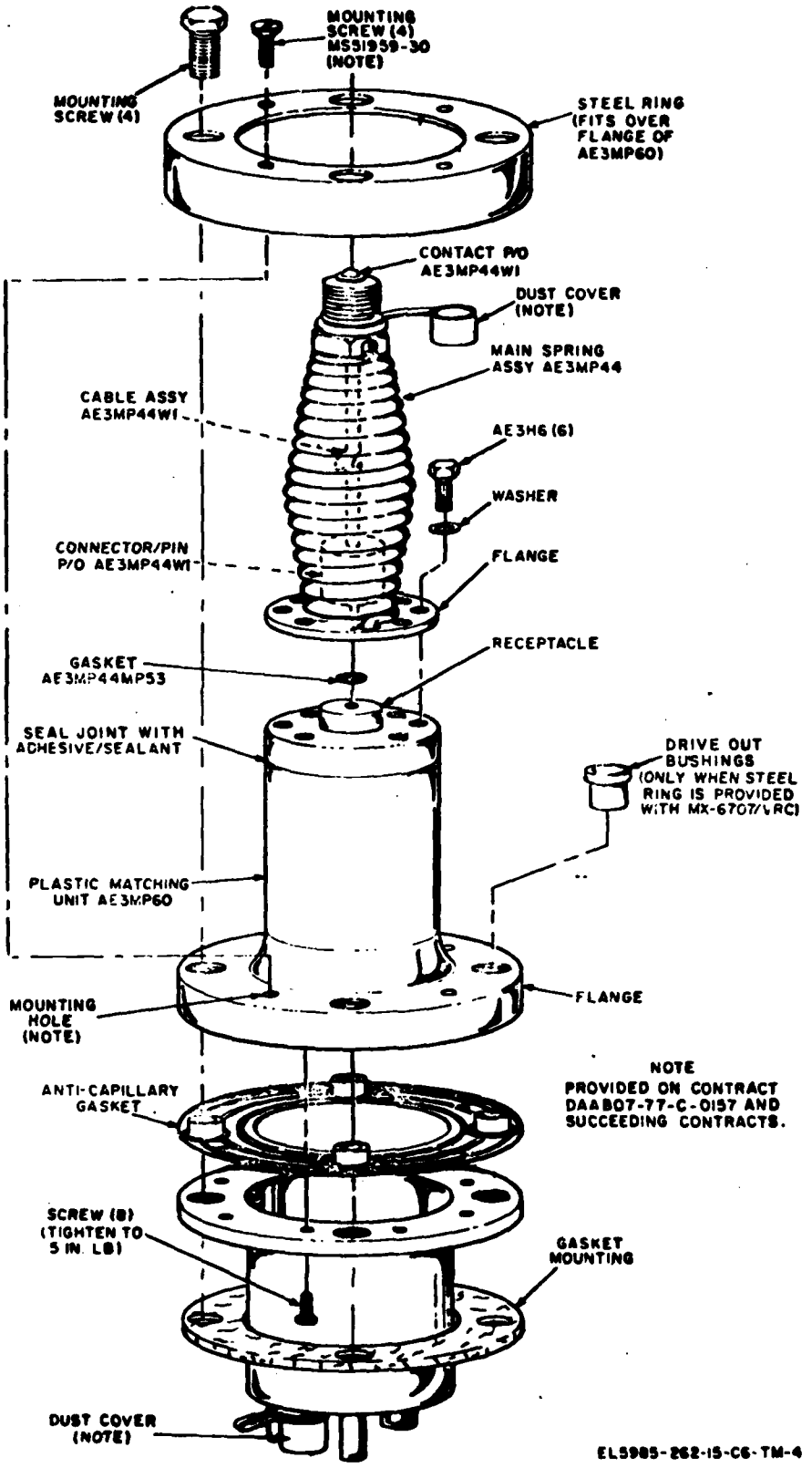


FIGURE C2 - EXPLODED VIEW OF MX-6707/VRC

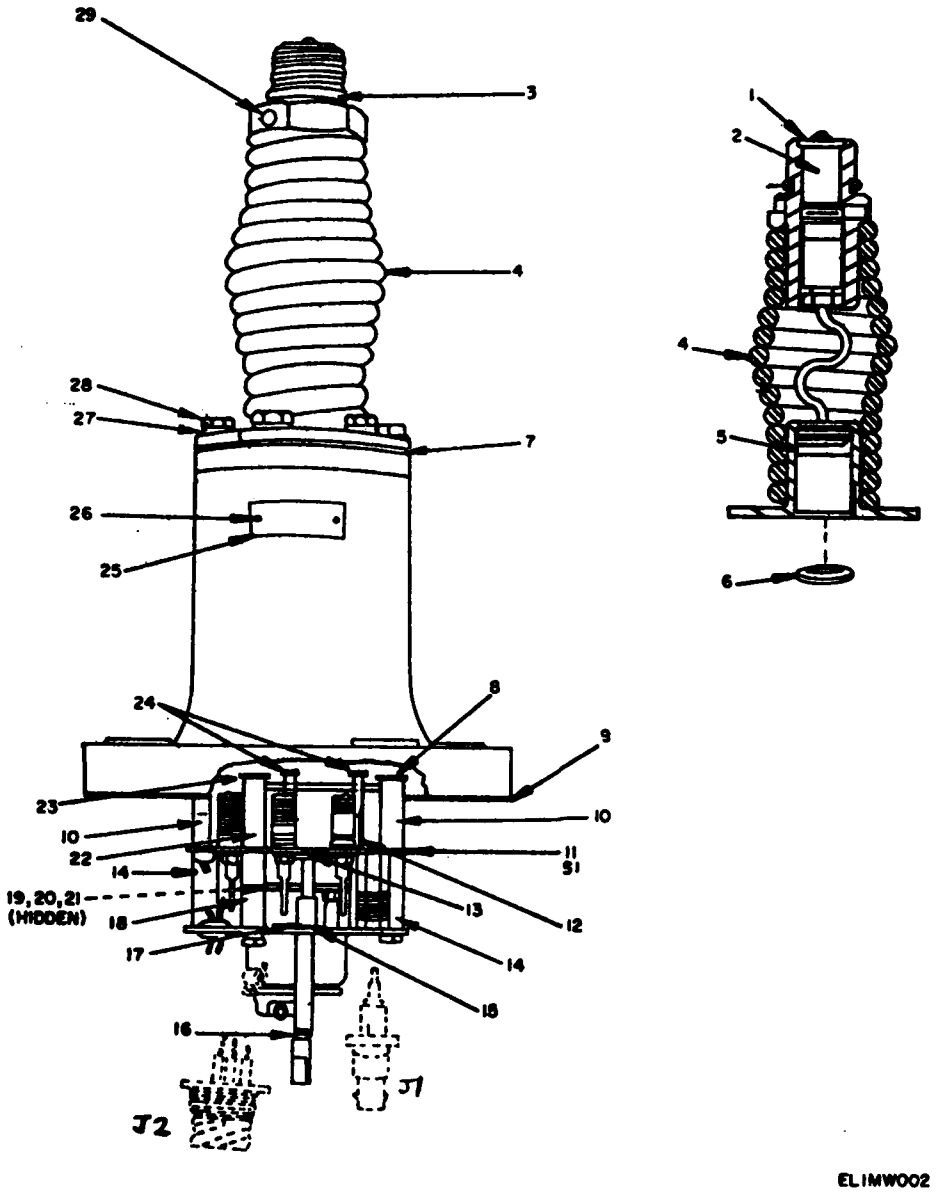
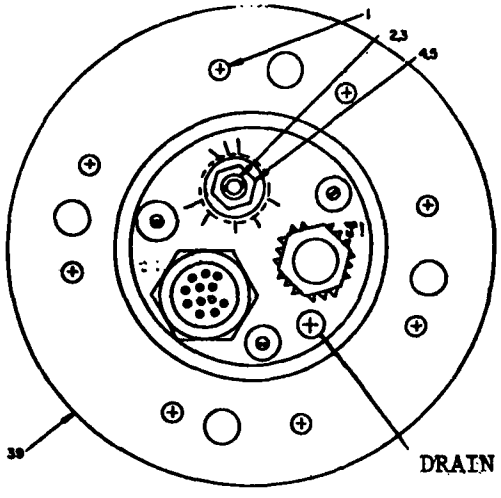


Figure 2. Matching unit base, antenna MX-6707/VRC.

FIGURE C3 - MX-6707/VRC ASSEMBLY



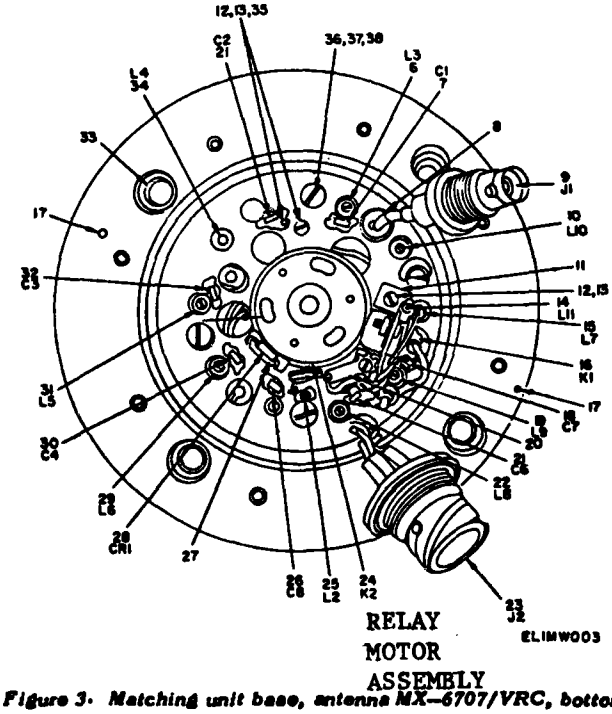


Figure 3. Matching unit base, antenna MX-6707/VRC, bottom view, exterior and interior

FIGURE C4 - BOTTOM VIEW MX-6707/VRC

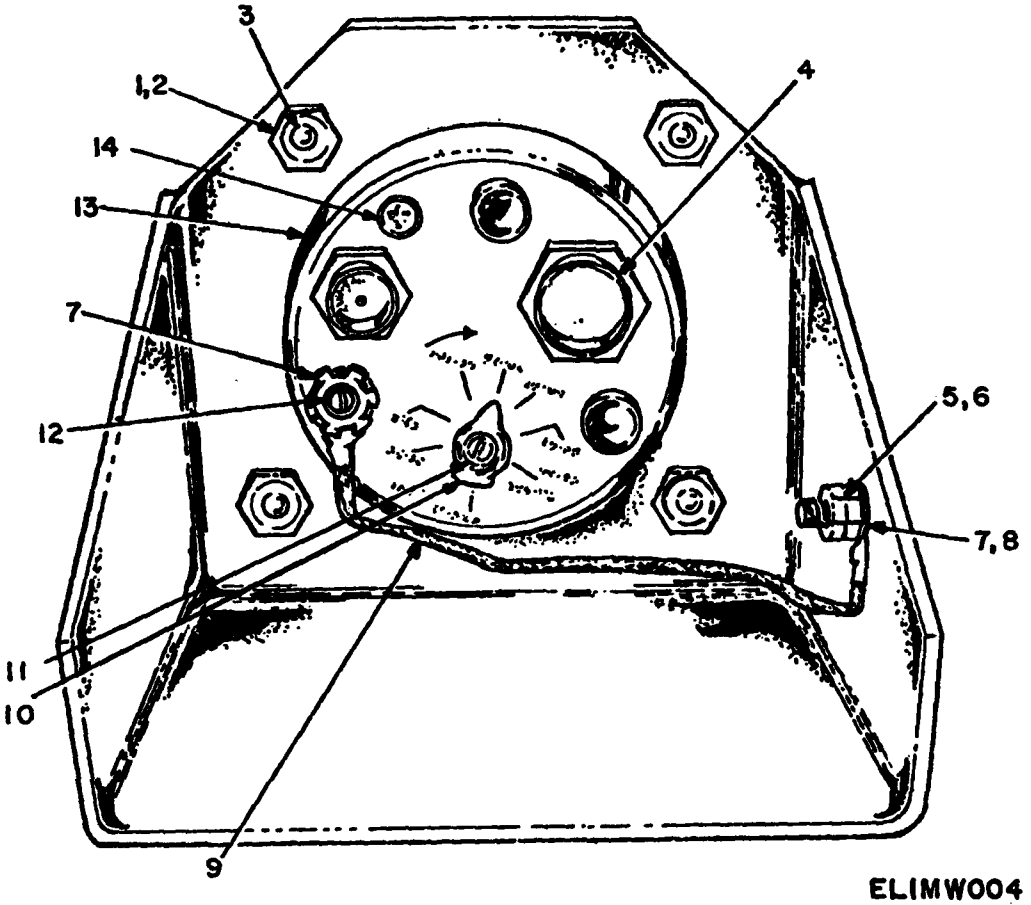


Figure 4. Matching Unit Base Antenna MX-6707/VRC, bottom view (mounted).

SECTION II REPAIR PARTS LIST (CONTINUED)

(1) ILLUSTRATION (A) FIG NO.	(1) ILLUSTRATION (B) ITEM NO.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION USABLE ON CODE	(7) UNIT OF MEAS	(8) QTY INC IN UNIT
4	1	PAOZZ	5306-00-225-9084	MS90726-29	96906	SCREW, MACHINE	EA	4
4	2	PAOZZ	5310-00-732-0558	MS51967-8	96906	NUT, HEXAGON	EA	4
4	3	PAOZZ	5310-00-637-9541	MS35338-46	96906	WASHER, LOCK	EA	4
4	4	XDOZZ		SMB542117	80063	CAP, PLASTIC	EA	1
4	5	PAOZZ	5310-00-880-7746	MS51968-5	96906	NUT, HEXAGON	EA	1
4	6	PAOZZ	5306-00-225-9084	MS90726-29	96906	SCREW, MACHINE	EA	1
4	7	PAOZZ	5310-00-080-9785	MS45904-60	96906	WASHER, LOCK	EA	1
4	8	PAOZZ	5310-00-889-8527	MS45904-72	96906	WASHER, LOCK	EA	3
4	9	PAOZZ	9905-00-192-9614	SMC283109	80063	LEAD, ELECTRICAL	EA	1
4	10	PAOZZ	5355-00-552-0451	MS91524-1	96906	KNOB	EA	1
4	11	XDOZZ		SMB542040	80063	SCREW, MACHINE	EA	1
4	12	PAOZZ	5305-00-857-5867	MS912203	96906	SCREW, MACHINE	EA	1
4	13	PAOZZ	5330-00-078-4184	SMB160382	80063	GASKET, RUBBER	EA	1
4	14	XDOZZ		SMB542041	80063	SCREW, SEAL	EA	1

FIGURE C5 - MATCHING UNIT BASE - ANTENNA MX-6707/VRC

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APPENDIX D

MODIFICATION DATA MX-6707/VRC

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APPENDIX D

As of 9/1/80 (Refer to Appendix B)

Antenna AS-1729/VRC Produced and Delivered:

Pre-1975 (through contract DAAB05-73-C-0010)

Approximately 58% not modified

Post-1975 (through contract DAAB05-78-C-0154)

Approximately 42% modified with 7/16" gasket and anticapillary gasket

Antenna AS-1729/VRC Produced and Delivered:

Pre-1977 (through contract DAAB07-76-C-0014)

Approximately 76% modified with 7/16" gasket and anticapillary gasket

Post-1977 (through contract DAAB05-78-C-0154)

Approximately 24% added modification of steel reinforcing ring and dust cover

NOTE 1: As of 7/9/80

(a) Total of 88,373 reinforcing rings procured; 21,000 on hand
(b) Total of 33,000 anticapillary gaskets procured; 21,361 on hand
(c) Total of 23,000 small (7/16") rubber gaskets procured; 21,000 on hand

NOTE 2: There are about 30,000 AS-1729/VRC Antennas procured per year that contain the four modifications. Separate requisitions for reinforcing covers number about 1,644 per year from Forway Industries, Inc. (Contract DAAB07-78-M-K490) and ROIS Mfg Co. (Contract DAAB07-78-C-4604).

NOTE 3: Various Manufacturers are:

AZCO
Forway Industries, Inc., Woodbury, NJ 08095
Hy-Grain Electronics Div. (Div of Telex Communications, Inc., Minneapolis, MN), Lincoln, NE 68505
Duffey Electronics, Belmar, NJ
ROIS Manufacturing Co., Philadelphia, PA
Century Metal Parts Corporation

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APPENDIX E

TYPICAL FIELD REPORTS
MX-6707/VRC

Next page is blank.

insulators. When procured, the mast base routinely passes acceptance testing when subjected to 1500 hits which are sufficient to deflect the antenna 90 degrees to the base. The upper insulator (NSN 5970-00-284-9627; cost $1.03) and lower insulator (NSN 5970-00-405- 8118; cost $2.57) can both be requisitioned as replacement items. This is a final report.

80L03-026 MATCHING UNIT-BASE, ANTENNA MX-6707/VRC - The top section of the MX-6707 (above the spring mount) gets dented in some manner (thought to be carelessness) when vehicles containing such units (e.g., M113 Armored Personnel Carrier) are having maintenance work performed. Also, the threads get damaged and are stripped, likely due to cross-threading and overtightening. There are about 600 vehicles, of various types, that contain this matching-unit base.

Solution or Act/Rqmts: It is recommended that the threads and contacts on the matching unit be protected before the vehicle is turned in for maintenance. A protective cap, shown in change 6 to TM 5985-262-15 is available as "protective cap," NSN 5340-00-811-5959, cost two cents. If a dust cover is not available, as noted on page 2-4 of the TM, put a layer of heavy-duty masking tape on the contact at the top of the MX-6707 to protect the contact and the threads. The TM also recommends (on page 2-2) applying a small quantity of Graphite Grease (NSN 8040-00-847-6387) to the threads of the spring mount assembly before screwing in Antenna Element AS-1730/VRC. Care should be exercised when screwing on the antenna elements. This is a final report.

79L04-051 MATCHING-UNIT BASE, MX-6707/VRC - Approximately ten to twenty matching unit bases per month reaching the DIO shops are not repairable because of water corroding the internal parts. There are approximately 1300 MX-6707 units in the division. Other than by the obvious cracks in the case, the path by which the water enters the matching unit base is unknown. It is suggested that matching unit bases be pressurized with dry nitrogen to prevent the entry of water.

Solution or Act/Rqmts: The water leakage is believed to be entering the matching unit bases through cracks in the lexan

case. The cracks are believed to be caused by stress from either over tightening the mounting bolts or from the antenna elements hitting trees. In either case, pressurizing the matching unit base would not prevent the crack in the case and water would still enter after the internal pressure has leaked through the cracks.

Improved gaskets and a stress-distributing steel mounting ring are available and now come with new matching units. The use of these items, as shown in TM 11-5985-262-15, change 6, would significantly reduce the incidence of water entry and cracks.

This is a final report.

79L05-057 MATCHING-UNIT BASE, MX-6707/VRC - Water enters the MX-6707/VRC from rain, cleaning with a high pressure hose, or condensation. Even if the drain screw is removed, a vacuum prevents the water from draining. Consequently, some parts rust and some frequencies cannot be used. In very few instances, water has been found in units containing the anticapillary gasket, reinforcing steel rings, and patching material. The Marines use silicone grease to prevent the entry of water. Out of 250 units on hand, there are thirteen failures every two months, mostly from moisture.

Solution or Act/Rqmts: AMSAA tested the MX-6707/VRC and found that using an anticapillary gasket (NSN 5330-01-017-3676; gasket, $0.81) and a steel reinforcing ring (NSN 5985-01-012-5425; cover, reinforcing, $1.19) does prevent water entering the MX-6707. Matching unit bases should be periodically checked by removing the drain screw and inserting an object into the hole, releasing the surface tension of any water collected allowing it to flow freely. Be sure to replace the drain screw after the unit is dry. (See PS Magazine, issue 293, April 1977, page 51.) If a unit shows water entry, look for cracks on the Lexon plastic top. Replace MX-6707 if cracks are noted. TM 11-5985-262-15 (Mar 69; Antenna AS-1729/VRC, page 2.2, paragraph 2.4.c(2)) indicates a maximum of 100 inch-pounds torque be applied to the hexbolts used to attach the MX-6707 to the vehicle's hull or to the antenna mounting bracket. If water entry is noted, and there are no cracks in the plastic top, please submit an EIR along with the defective matching unit base. This is a final report.

APPENDIX F

CONDENSED FINDINGS REPORT

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DEPARTMENT OF THE ARMY

U. S. ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY
Aberdeen Proving Ground, Maryland 21005

DRXSY-LM

SUBJECT: Production Control Board Meeting on Antenna, AS-1729 and Matching Unit MX-6707

23 JAN 1980

Commander
USA Communications & Electronics
Materiel Readiness Command
ATTN: DRSEL-MM
Fort Monmouth, NJ 07703

1. During its visits to field users of the AS-1729, AMSAA discovered a world-wide problem with water leaking into the MX-6707 and preventing the operation of the matching unit because of corrosion of the contacts, motor, and parts.

2. CERCOM has instituted two improvements that are capable of being applied in the field. They are an improved gasket to seal the mating of the top and bottom sections of the case and a metal ring to distribute the mounting, bolt stress, and prevent direct access of water into the mating surfaces.

3. All the leaking matching units that AMSAA has found in the field have either a cracked case and/or the old style gasket. In 1978, the DIO shop at Fort Bliss attempted a total recall of matching units in order to install the new gasket and metal rings. Before the recall, 75% of the failures of the matching unit were due to corrosion. Very few failures are due to corrosion since the conversion and most of these were missed during recall (the recalls were marked with a spot of paint on internal parts). Present failures are due to wear-and-tear, lost parts, physical abuse, etc.. Source: Mr. James Nicholopoulos, Chief, C&E Section, DIO, Fort Bliss, AV 978-2887/6783.

4. AMSAA strongly recommends that:

a. DARCOM provide the users of the MX-6707 a free kit consisting of the new gasket, the metal ring, and a tube of silicone grease for installing the gasket.

b. DARCOM fund the DIO shops to install the free kit on those matching units manufactured before the improvements where incorporated

DRXSY-LM
SUBJECT: Production Control Board Meeting on Antenna, AS-1729 and Matching Unit MX-6707

during manufacturing.

Discussion: The cost of the parts in the kit, $6.75 (gasket = $1.09, metal ring = $1.50, silicon compound = $4.16) should be contrasted to the cost of a new matching unit of $139.00 or the cost of a new AS-1729 (which are being shipped in lieu of the MX-6707 at a cost of $156.00). The Army could break even at a cost ratio of 20:1 if 1/20th of the kits were installed to save one MX-6707.

The Fort Bliss DIO estimates that it requires 1/3 man hour to install the kits in an assembly line fashion. Thus, at a cost of $25.00 per man hour, DARCOM could fund the installation of the kits for a total cost of $15.08 ($6.75 for kit plus $8.33 for labor). This is still 1/9th of the cost of the MX-6707.

5. If it is deemed unwise to fix the source of leaking for the matching units, then it is suggested that the current drain hole in the base of the matching unit be enlarged. The problem in the field is that the screw hole in the base of the matching unit is not large enough to allow the collected water to run out. The combination of dirt and water surface tension, and the lack of positive pressure all combine to prevent drainage when the screw is removed. Increasing the drain screw size from its present #10-32 to at lease 1/4" would help.

6. The POC at AMSAA for this action is Mr. Hal Forst, AV 283-4473.

FOR THE DIRECTOR:

John J. McCarthy

JOHN J. McCARTHY
Chief
Field Equipment & Technology Division

CF:
DRSEL-ME
DRSEL-PA

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
DRSEL-ME-C (FM)	Field Survey of AS-1729/VRC

TO Dir, Log Engrg
ATTN: DRSEL-LE-CR-1
(S. Rodgers)

FROM Dir, Maint Engrg

DATE 3 JUN 1980 CMT 1
Mr. O'Donnell/efb/21191

1. Reference is made to PCB meeting, 24 Jan 80, which tasked this directorate with determining the ratio of post-75 production units to pre-75 units.

2. Results of this investigation are inclosed (Incl 1).

3. Using the 46% pre-75 units and the DSM data of 142,300 AS-1729/VRC in the field, it would appear that 65,458 units may exist without the improved gasket and torque ring.

4. Preliminary results of another survey show that water damage is dramatically reduced with these improvements.

5. It is suggested that a Product Improvement Program, to add the gasket and torque ring, be given very serious consideration.

6. If further information is required, please contact Mr. M. O'Donnell, X 21191.

FOR THE DIRECTOR:

ROBERT B. MIDER
Chief, Comm/ADP Eq Spt Division
Maintenance Engineering Directorate

1 Incl
as

ROBERT B. MIDER
Chief, Comm/ADP Eqpt Spt Div

CF:
DRSEL-ME-CN w incl
DRSEL-ME-FST w incl
DRSEL-MMR-SR w incl
DRSEL-PA-SA (Barron) w incl
✓Cdr, AMSAA, ATTN: DRXSY-LM (Forst), Aberdeen Proving Grounds, MD 21005

DA FORM 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

FIELD SURVEY of AS-1729/VRC ANTENNAS

CONUS

LOCATION	# of Pre-75	# of Post-75
Fort Bragg	54	21
Fort Knox	30	70
Fort Bliss	7	194
Fort Polk	58	42
Fort Campbell	35	65
Fort Hood	54	108
Fort Riley	72	28
Fort Carson	110	11
Fort Stewart	44	56
Fort Lewis	46	54
	510	649
EUROPE		
Darmstadt	10	13
Southern Germany	38	28
	48	41
KOREA	24	76
HAWAII	78	21
	102	97
TOTALS	660 (45.6%)	787 (54.4%)

APPENDIX G

DAMAGE EVIDENCE

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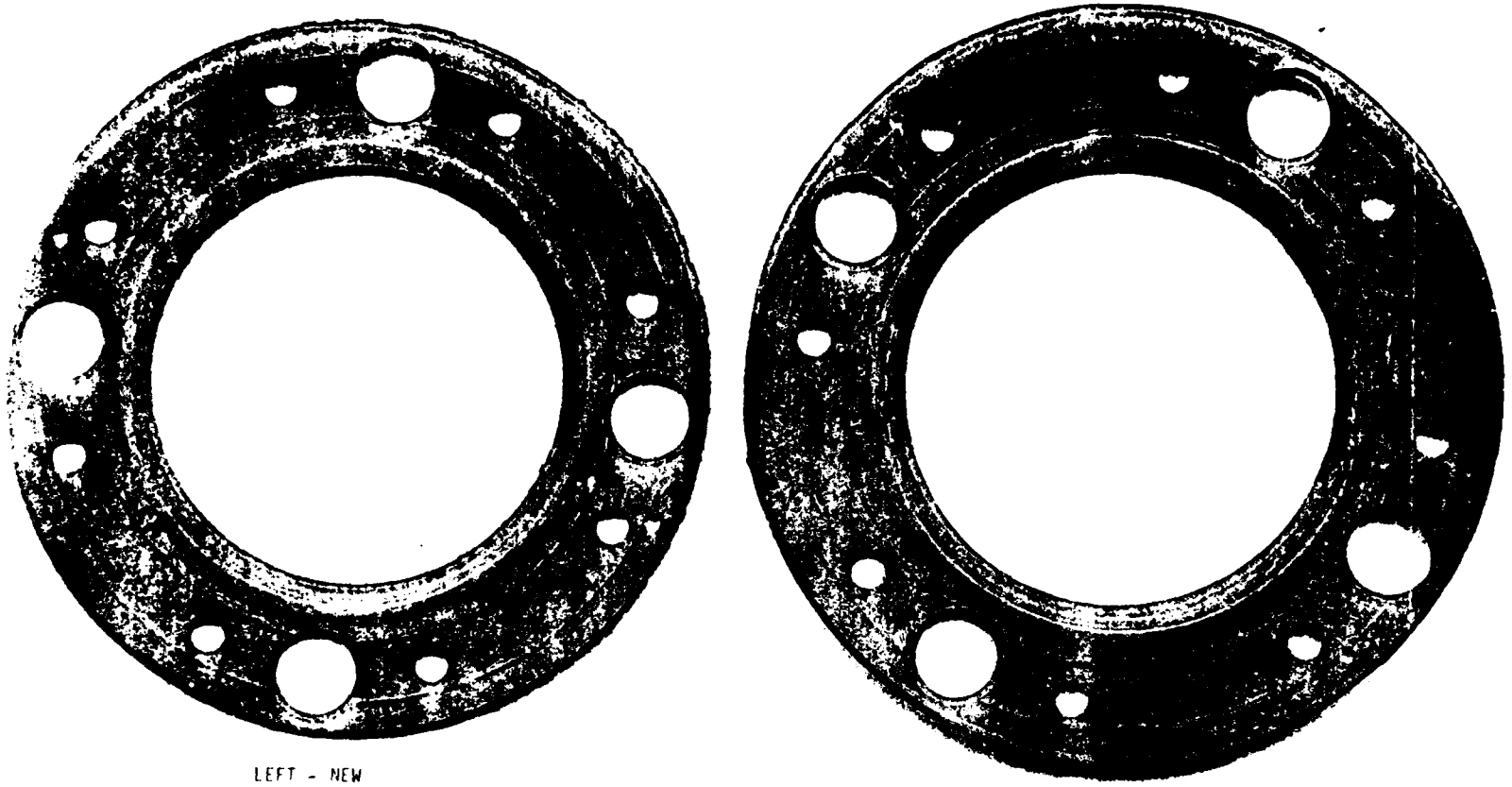


LEFT - NEW

RIGHT - USED

FIGURE G1 - GASKET DAMAGE

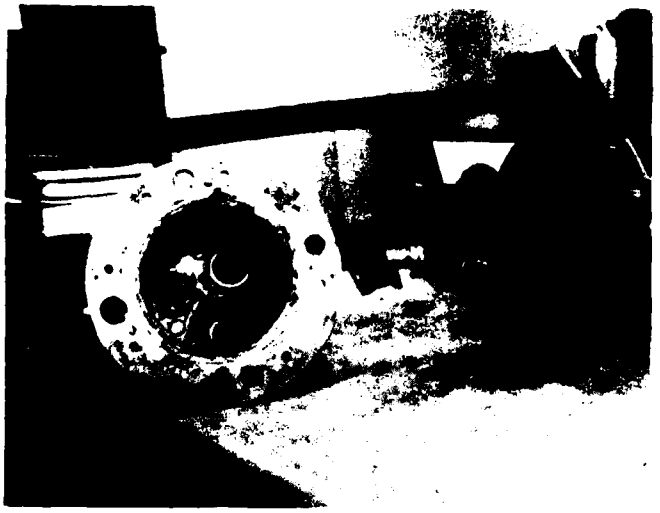


FIGURE G2 - GENERAL INTERIOR CORROSION

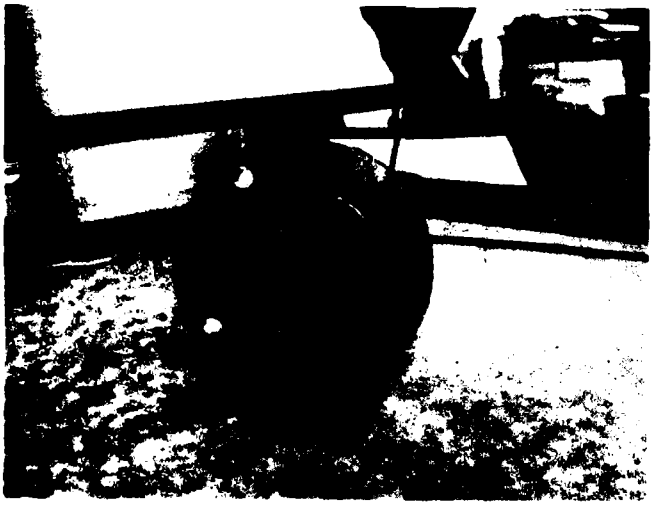


FIGURE G3 - EXTERIOR (BOTTOM) CORROSION

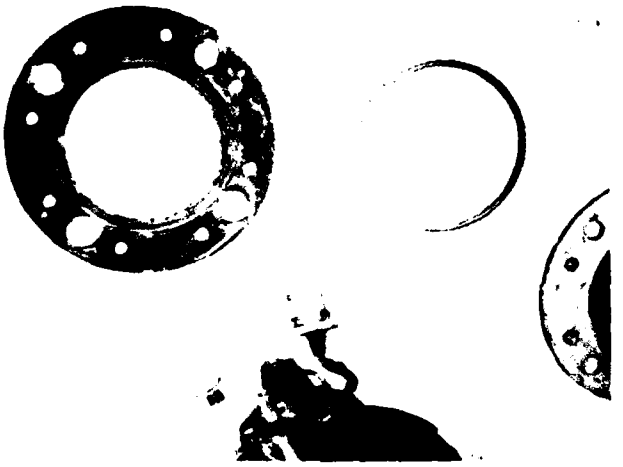
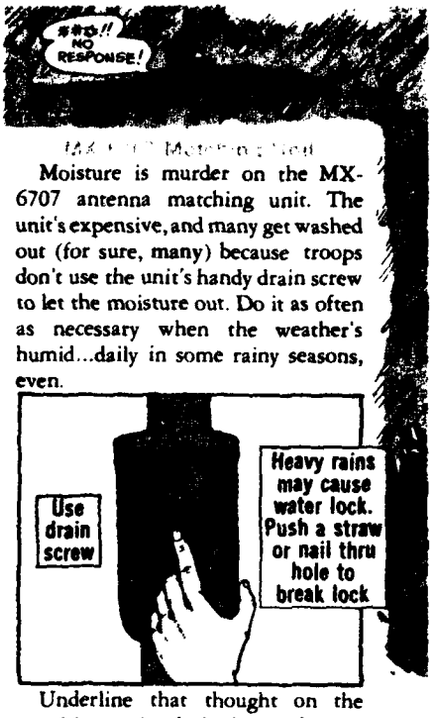


FIGURE G4 - GENERAL DAMAGE



Moisture is murder on the MX-6707 antenna matching unit. The unit's expensive, and many get washed out (for sure, many) because troops don't use the unit's handy drain screw to let the moisture out. Do it as often as necessary when the weather's humid...daily in some rainy seasons, even.

Underline that thought on the matching unit: drain it as often as necessary. Make a check. If water drains out each day, drain it each day.

Radio sets, intercoms, control boxes, all are vulnerable in inclosed areas such as tanks and carriers. That's extra true when you wash the vehicles.

Best bet when you wash them (especially in an APC where you're likely to really spread the water around) is, first...remove the radio. Then, let the track dry thoroughly before you reinstall the radio.

Otherwise, corrosion will have a ball. Commo gear closed up in a hot, damp track is like damage waiting to happen.

FIGURE G5 - PS MAGAZINE, ISSUE 331 - JUNE 1980, REPORT ON MX-6707/VRC

APPENDIX H

MATERIEL TESTING DIRECTORATE EFFORT

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DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
DRXSY-LM	Proposed Test & Approval of Funds for Task Radio Set VRC-12, Job Order U415

XX THRU: C, FEAT Div FROM C, C&E Team DATE 11 Feb 80 CMT 1
TO: C, Plans/Program & Budget Mr. Harris/ka/5104
ATTN: Mrs. M. Smith

1. As part of FEAT Division Task Radio Set VRC-12, Job Order U415, the C&E Team has been looking over the problems of inoperability of the MX-6707/VRC Matching Unit-Base Antenna caused by water or moisture entry into the unit.

2. Discussions have been held with personnel of MTD. Their proposal is attached as Incl 1.

3. The proposal has been reviewed by the C&E Team, FEAT Div., and is acceptable.

4. Request funds of $2,500.00 be allocated and transferred to MTD to accomplish this task.

HAROLD C. FORST

1 Incl
as

APPENDIX H

REPORT H1

Proposal
Determination of Cause(s) of Moisture In
MX-6707/VRC Matching Unit - Base Antenna

31 Jan 80

FOR: Mr. Harry N. Harris
AMSAA
Bldg AA-359
Extension 4055/4473

Prepared By: Mr. John A. Robinson
C, Environmental Test Section
Engr Test Br, M&A Div, MTD
Bldg AA-436
Extension 3787

1. This proposal outlines a multi-step approach developed as a means of determining the cause of the moisture problem in the subject antenna base. The steps were developed following review of the enclosed report (Incl 1) and a meeting with Mr. Harris to examine the component and review with him in detail the suspected nature of the failure.

2. The steps of this proposal are presented below in the order they are to be accomplished:

a. Review damaged bases, any drawings available plus any information relevant in an effort to determine all possible causes of the failures.

b. Pressurize the base with air and immerse the base in water to determine the location of any leaks.

c. Determine the operating temperature of the base by either having it provided by Mr. Harris or mounting the base on a jeep with antenna and radio and operating the system for approximately 24 hours. During this operational period a thermocouple(s) will be attached to the outer skin of the base and monitored to determine time of occurrance and value of the peak temperatures plus provide data to determine average operating temperatures and times as required.

d. Place the base in a temperature chamber and heat it to the operating temperature (para 2.c), remove it from the chamber and immediately apply a high pressure stream of water to it simulating the wash down process of the vehicle by operators.

e. Disassemble base and inspect for evidence of water or moisture.

f. Dry (if necessary) and reasemble the base with a humidity gauge and a water indicating gauge mounted internally. Also apply a water-soluble dye to mating parts as a means to indentify areas of water entry.

g. Perform a 24 hour temperature-humidity test with cycles predetermined to be representative of a typical day in an operational area such as the southern part of the country. Record the output of the internal instrumentation along with the ambient condition.

h. If moisture is indicated by the instrumentation, disassemble the base and determine any indications of points of entry from dye. Perform additional analysis and/or tests as deened necessary at this point. If no evidence of moisture is shown by the instrumentation, proceed to step i.

i. Mount the base with antenna and radio on jeep. Operate the system while running the jeep several laps over the Munson Belgian Block course until the antenna base reaches its operating temperature. Then quickly apply a high pressure stream to the base and monitor the humidity/water gauges for evidence of moisture.

j. If still no moisture is evident, review progress to date and develop another plan of action.

3. The estimated cost of this total proposal is 152 mannours consisting of:

Engr Test Branch (Engr/Tech)--120 MH
Environmental Equipment Operator--26 MH
Driver--8 MH

This amounts to a total cost of $2500.00.

4. Upon acknowledged agreement with this proposal (or agreed upon modification thereof including cost), the investigation will begin as soon as hardware and any required drawings/information plus funds become available. The expected time required to complete all steps of the proposal is 13 to 15 days.

J. A. ROBINSON
C, Env Test Sec
Engr Test Br

CF:
Mr. Harris
Mr. Byerly
Mr. Gross
Mr. McGlothlin

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
STEAP-MT-G	Report No. 80-DF-74. Determination of Cause(s) of Moisture in MX-6707/VRC Matching Unit - Base Antenna

TO AMSAA
ATTN: Mr. Harry Harris
Bldg 359

FROM C, Engineering Test Br
MTD

DATE 15 Jul 80
Mr. Hiob/cw/4534

CMT 1

1. The Engineering Test Branch was requested to determine the cause of the moisture problems in the subject antenna base. A test proposal was developed by this Branch and testing was conducted from 10 April through 20 May 1980.

2. Two damaged Base Antenna Matching Units returned from field operations were used in this evaluation. Inspection of the units indicated that moisture entered the interior cavity through the gasket area between the plastic and metal flanges. Both units had fractures adjacent to the four flange through-holes provided for attaching the Base Antenna Matching Unit to a vehicle or fixture. The fractures were probably the result of excessive mounting bolt torques used when securing the unit to its mounting fixture. Both units inspected had metal inserts or bushings in these holes; the bushings were shouldered at the top and extended through the plastic flange to within approximately 1/8 inch of its full thickness. When the bolts were overtorqued, the metal bushings apparently fractured the plastic flange and provided a path for water entry.

3. A redesigned antenna base was tested. It incorporated a metal flange adapter ring (which replaced the metal bushings) and a one-piece anticapillary gasket (which replaced the "O" ring and flat gasket assembly). Tests of the redesigned base unit were conducted using both types of gasketing (anticapillary; and the old flat gasket assembly).

4. Several tests (immersion, internal pressure and high pressure hose washings) were conducted on the redesigned base unit to determine whether an effective water seal could be achieved. A radio transmission temperature rise test was also conducted. All tests were conducted on the base unit alone except for the radio transmission temperature rise test--during which the unit was mounted on a tracked vehicle.

5. Either type of gasketing, when installed in the redesigned base unit in accordance with the installation instructions, will prevent water entry into the interior cavity; however, the resiliency of the anticapillary gasket material does not appear to be adequate at high temperature. Complete test results are attached as Inclosure 1.

1 Incl
as

ROWLAND G. BYERLY

DA FORM 1 FEB 67 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

SECTION 2. DETAILS OF TEST

2.1 INSPECTION OF FIELD-RETURNED UNITS

2.1.1 Objective

To determine the cause of moisture penetration into the two antennas returned from field issue.

2.1.2 Criterion

None.

2.1.3 Data Acquisition Procedure

Two Base Antenna Matching Units, MX-6707/VRC Serial No. 40593A and 05983C were used in this portion of the investigation. The units were separated at the flanged mating of the metal base cover and the plastic (Lexan) antenna mount. The units were inspected and general observations were recorded and analyzed.

2.1.4 Results

The following observations were made as a result of the inspection:

a. The plastic portion (Lexan) of the Base Antenna Matching Unit was cracked or fractured at all four mounting holes (vehicle-to-antenna) on both units.

(1) Both mounts were fractured from hole to outside edge.

(2) Both mounts contained two cracked areas from hole to interior cavity but not through to the exterior surface.

b. The stepping motor, switch housing and all the ferrous metal components within the base antenna were rusted and corroded.

c. There was no water-path available from the antenna-whip spring-mount to the base mount cavity.

2.1.5 Analysis

The degree of rust and corrosion of the internal components indicates that substantial quantities of water had entered both units. Water appeared to have entered the interior of the base mount through the gasketed plastic-to-metal flanged area (figure B-1).

Securing the base antenna matching unit to a mounting fixture requires that four bolts pass through its flanged area. The bolt holes in the flange are counterbored and contain metal inserts or bushings.

The bushings extend through the "Lexan" plastic to approximately one-eighth inch of the thickness of the flange to allow for compression of the flange gasket. A maximum of 17513 N.m (100 pound-inches) torque is specified by the installation instructions; but from the observed damage to the units inspected it appears that bolt overtightening had occurred (probably in the field without availability of a torque wrench). Excessive bolt torquing could have caused the bushings to deform the "Lexon" plastic and cause the cracks and fractures noted.

2.2 INSPECTION OF NEW UNITS

2.2.1 Objective

To make an objective evaluation of the modified base antenna matching unit.

2.2.2 Criterion

None.

2.2.3 Data Acquisition Procedure

Base Antenna Matching Unit, MX-6707/VRC, Serial No. 20211H, which is a modified version of the unit, was used in this investigation. The unit was separated at the flanged mating of the metal base cover and the plastic (Lexan) antenna mount. The unit was inspected and general observations were recorded.

2.2.4 Results

The following observations were made as a result of the inspection:

a. The steel inserts or bushings have been eliminated and a steel flange-ring adapter has been added.

b. The flat rubber flange-to-metal base cup gasket and "O" ring assembly had been eliminated and replaced with an anti-capillary one-piece gasket.

2.2.5 Analysis

The flange ring adapter should better distribute the mounting stresses encountered when the base mount is secured to a mounting fixture.

Better sealing qualities should result from the substitution of the improved anti-capillary flange gasket.

Incorporation of the two approved modifications should correct the cause of the damaged and leaking Base Antenna Matching Units. Results of further testing as contained within this report confirm this analysis.

2.3 PRESSURE TEST OF NEW UNIT

2.3.1 Objective

To determine the sealing ability of the two types of flange gasket configurations when internally pressurized.

2.3.2 Criterion

None.

2.3.3 Data Acquisition Procedure

Only the new type Base Antenna Matching Unit was available for testing; that is the one using the flange adapter ring as opposed to the one with a metal insert or bushing in each of the four mounting holes.

Two gasketing methods were evaluated using this unit. First the new one-piece anticapillary gasket; then the original two-piece (flat gasket with separate "O" ring) assembly was tested. Both gasket types were prepared as per instructions in the manual by coating them with silicone grease and tightening the flange ring assembly screws to their specified 876 N.m (5 pound-inches) torque.

The drain screw was removed from the metal base cover and replaced by a threaded adapter for use in pressurizing the inside of the antenna. The unit was then pressurized to 72.395 kPa (10.5 psig) and submerged in room temperature water for 15 minutes. During this time the unit was observed to determine if any leakage of air occurred as would be indicated by water bubbling.

2.3.4 Results

There was no indication of leakage with either type gasketing technique evaluated when the unit was internal pressurized to 72.395 kPa (10.5 psig).

2.3.5 Analysis

Both gasketing techniques appear adequate to protect against water entry when properly installed in an undamaged base antenna matching unit.

2.4 IMMERSION TEST (HIGH TEMPERATURE)

2.4.1 Objective

To determine the sealing ability of the two types of flange gasket configurations when the base antenna matching unit was conditioned at an elevated temperature, then immersed and cooled.

2.4.2 Criterion

None.

2.4.3 Data Acquisition Procedure

The base unit was placed in a conditioning chamber and the temperature was raised to 71° C (160° F). When the temperature of the base unit had stabilized it was removed from the chamber and immediately immersed in a dye solution of sodium fluorescein dye and allowed to soak for 2 hours duration. (General view of base unit in dye solution is shown in figure B-2.) The unit was removed from the immersion vessel, dried, disassembled and visually inspected for indication of water entry into the internal cavity of the base unit. This procedure was accomplished for each type of flange gasket.

2.4.4 Results

a. Anticapillary Gasket. Several small droplets of dye solution were found in the gasket-to-plastic surface of the antenna between the second ridged area and the large "O" ring seal and groove portion of the anticapillary gasket.

b. "O" Ring-Flat Gasket. Several small droplets of dye solution were found in the gasket-to-plastic and gasket-to-metal surfaces of the antenna. No moisture penetrated the "O" ring seal and groove area.

2.4.5 Analysis

Results indicate that either type gasket when properly installed in an undamaged base antenna matching unit will prevent moisture from entering the interior of the unit.

Flange mounting screws were pre-test torqued to 876 N.m (5 pound-inches). Post-test torques of these screws were measured at 525 to 613 N.m (3 to 3.5 pound-inches) when the anticapillary gasket was used. Comparison of the used gasket with an unused gasket revealed a 9-millimeter (3/8-inch) increase in the gasket diameter. The gasket stretch was probably the result of the elevated temperature and flange compression of the gasket. The test temperature and screw torque used were not abnormally high and should not have caused the gasket to permanently expand and set. If the anticapillary gasket is to replace the formerly used gasket assembly, the composition of the gasket material should be evaluated for resiliency at high temperatures since it does not appear to be adequate.

2.5 HIGH PRESSURE HOSE TEST

2.5.1 Objective

To determine the sealing ability of the two types of flange gasket configurations when the base antenna matching unit was conditioned at an elevated temperature then sprayed by a high pressure hose simulating vehicle wash-down procedures.

2.5.2 Criterion

None.

2.5.3 Data Acquisition Procedure

The base unit was placed in a conditioning chamber and the temperature was raised to 71° C (160°F). When the temperature of the base unit had stabilized it was removed from the chamber and subjected to a high pressure water stream. The water was directed against the sides for approximately 6 minutes total time, with the base unit rotated 90 degrees each minute and a half. (General view of base unit during High Pressure Hose Test is shown in figure B-3.) The base unit was then disassembled and visually inspected for indication of water entry into its internal cavity. This procedure was accomplished for each type of flange gasket.

2.5.4 Results

a. Anticapillary Gasket. There was no water penetration at the gasket or into the interior of the unit.

b. "O" Ring-Flat Gasket. There was no water penetration at the gasket or into the interior of the unit.

2.5.5 Analysis

Results indicate that either type gasket when properly installed in an undamaged base antenna matching unit will prevent moisture from entering the interior of the unit.

2.6 RADIO TRANSMISSION (CONTINUOUS SERVICE)

2.6.1 Objective

To determine the stabilized temperature of the Base Antenna Matching Unit under continuous transmitting conditions.

2.6.2 Criterion

None.

2.6.3 Data Acquisition Procedure

The Base Antenna Matching Unit was instrumented with four thermocouples, 2 external and 2 internal, then mounted on a tracked vehicle. Instrumentation and associated equipment used in conducting this test was as follows:

a. Receiver-Transmitter Radio, RT524A/VRC, Serial No. 19922B.

b. Hewlett-Packard, Model 6274B DC Power Supply, Serial No. 1712A03032.

c. Doric, Model 230 Data Logger, Serial No. 63758.

d. BIRD, Model 43, Power Meter, In-line, Serial 55461.

A general view of the instrumentation is shown on figure B-4.

After recording the nonoperating temperatures of the base unit the radio was turned on and the transmitter actuated by jumpering the proper connector pins. The radio remained in the transmit mode of operation for 6 continuous hours and the base unit temperatures were recorded at 5-minute intervals throughout the six hours. Output and reflected power were recorded initially and at each 2-hour period thereafter until conclusion of the test.

2.6.4 Results

Temperature stabilization of the base unit was obtained after approximately 5 hours of continuous transmission. Internal temperature rises of 10° and 12.2° C (18° and 22° F) were measured. Time-history graphs of the various measurement points are included on figure B-5.

In-line power measurements recorded initially and at 2-hour intervals are tabulated below:

Elapsed Time - Minutes	Power - Watts	
	Out	Reflected
0	51	5
120	47	5
240	48	5
360	45	6

2.6.5 Analysis

The temperature rise of the antenna base unit as a result of continuous radio transmission was thought to be a probable cause of damage to the "Lexan" plastic base. However, the approximate 11° C (20° F) internal temperature rise and 8° C (14° F) surface temperature rise measured after 6 hours continuous transmission do not support this theory.

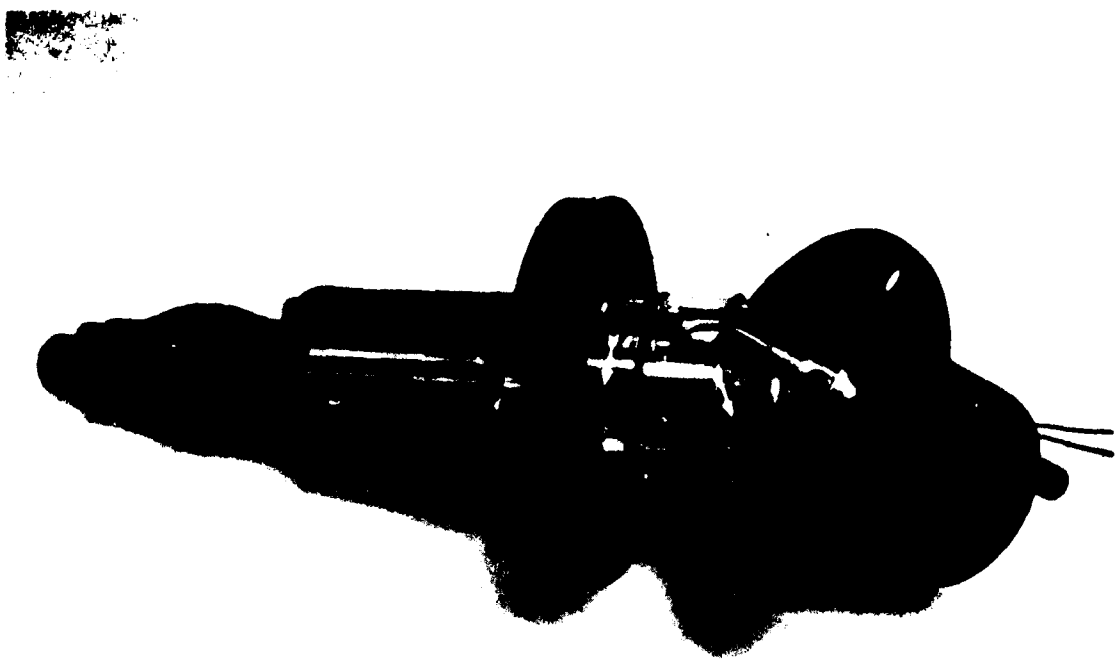

Figure B-1. General view of disassembled base unit showing gasketed flange area and arrows indicating interior cavity thermocouple locations.

Figure B-2. General view of base unit immersed in dye solution.

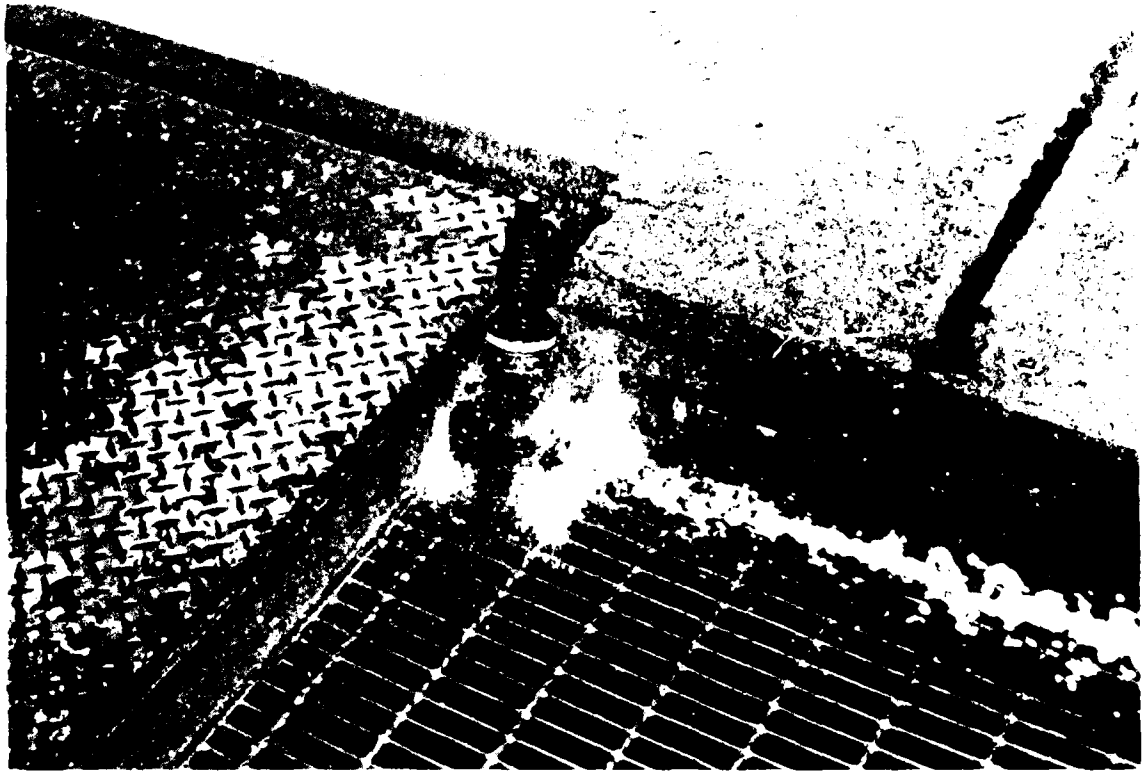

Figure B-3. General view of base unit during high pressure hose test.

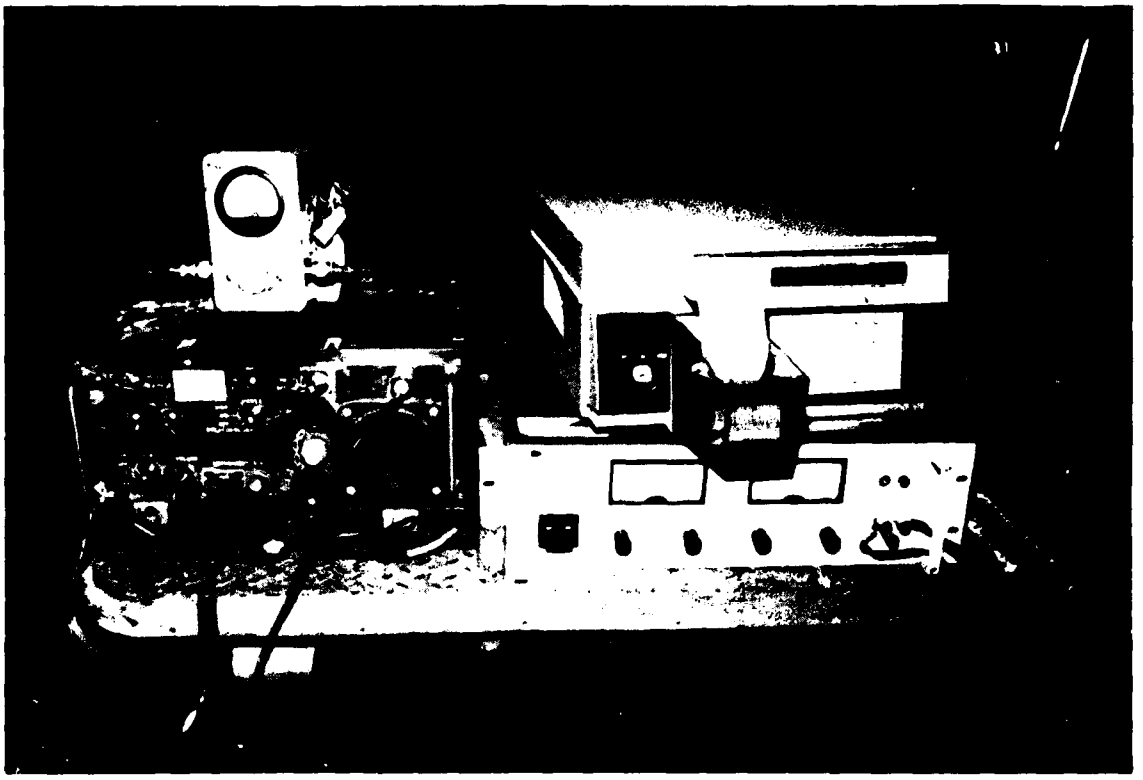

Figure B-4. General view of the instrumentation used for the continuous radio transmission test.

BEE 20x20 TO INCH

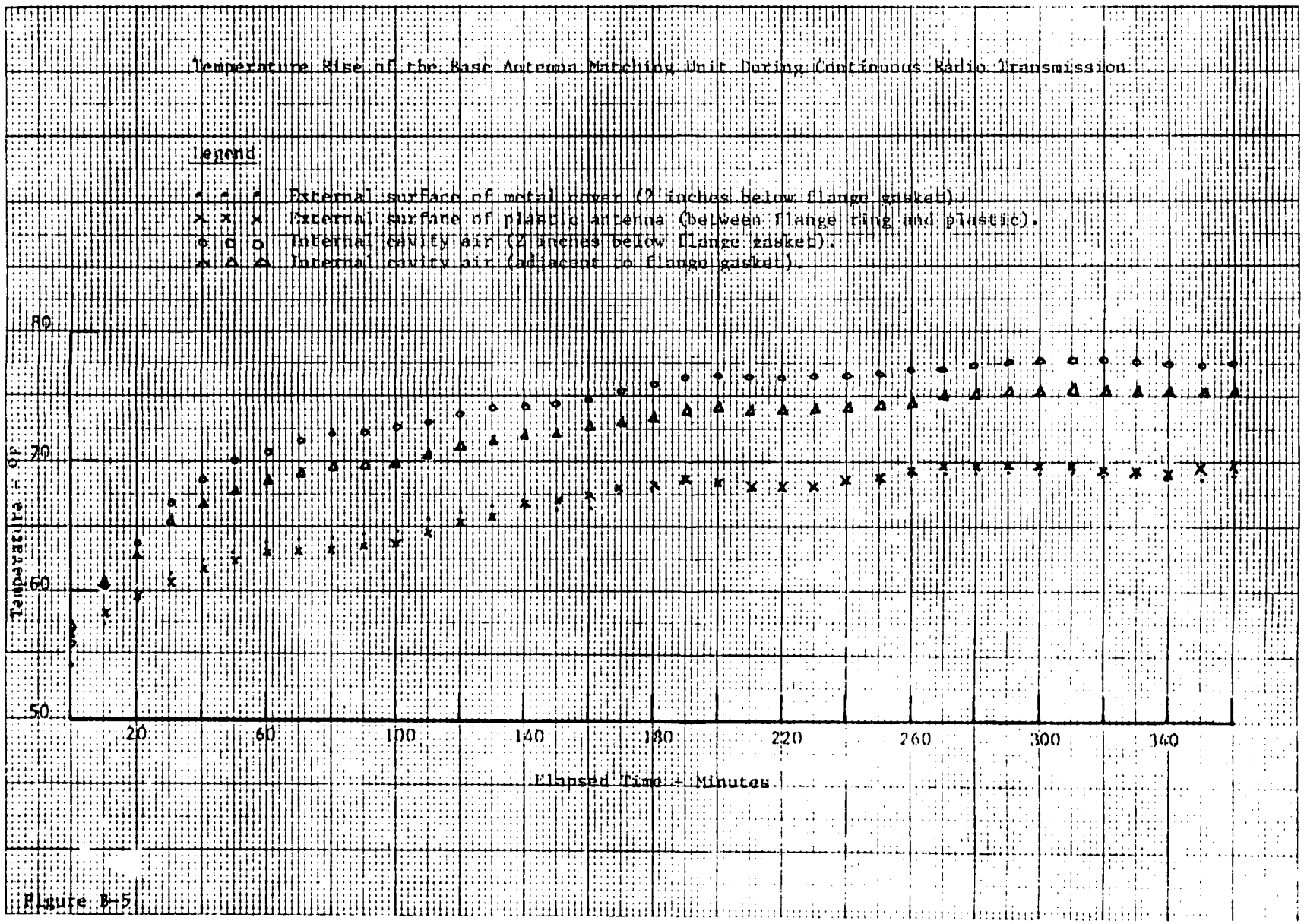

Figure B-5

APPENDIX I

GASKET PHOTOGRAPHS

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FIGURE I1 (LEFT) - DAMAGED GASKET

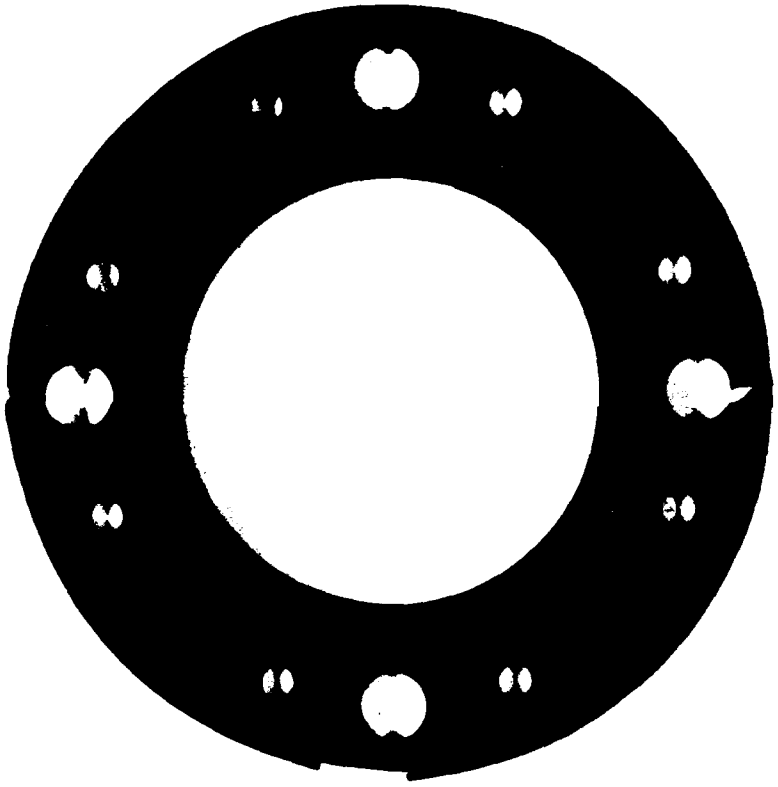
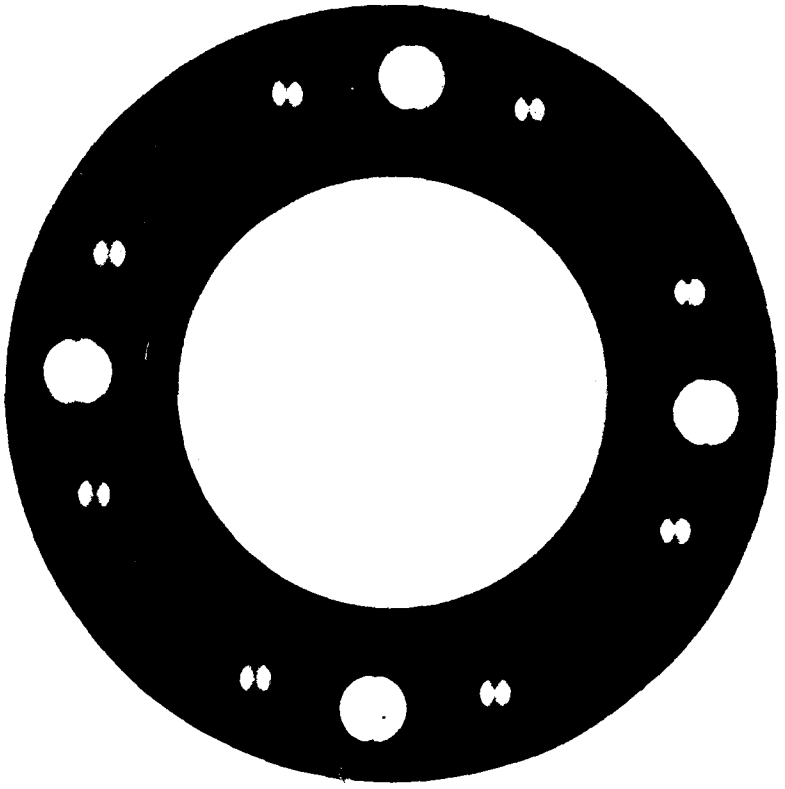


FIGURE I2 (RIGHT) - GASKET W/"O" RING



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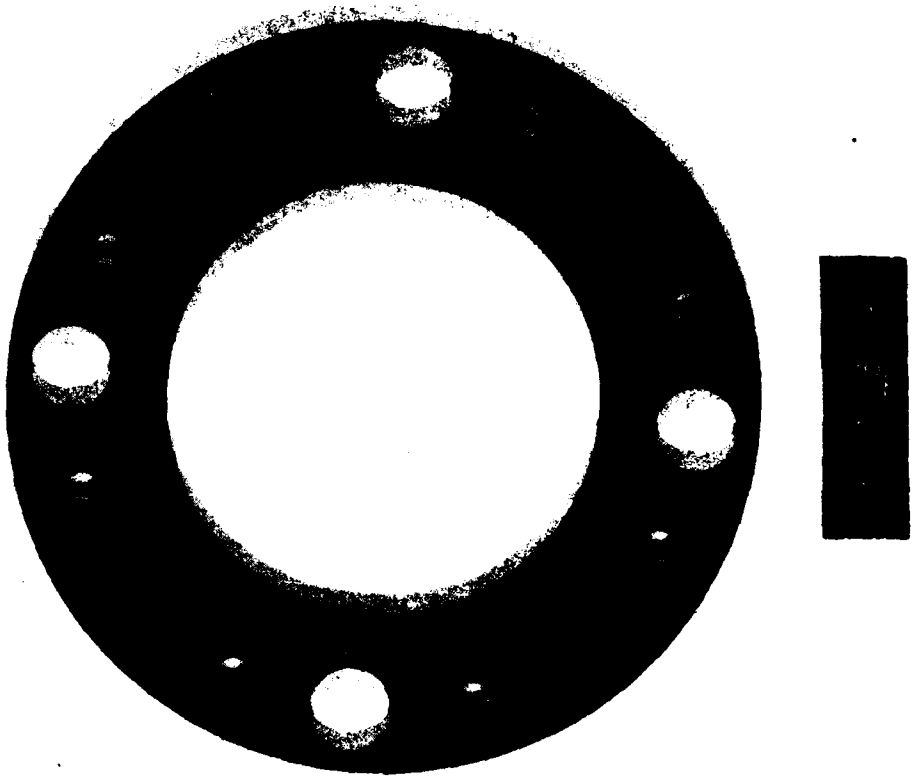

FIGURE I3 - SPECIAL GASKET

APPENDIX J

CLEANING PROCEDURES - 25TH INFANTRY DIVISION - CHEMICAL PROCESS

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APPENDIX J

CLEANING PROCEDURES

MATCHING UNIT, MX-6707, CLEANING PROCEDURE

1. Matching Units received at USASCH Shop #2, GS Electronic Maintenance Facility, as unserviceable items are processed through the Receiving Section and job ordered to the Radio Section on a DA Form 2407. An intershop job order is prepared and the units are sent to the Shop Support Section for cleaning, painting and physical repair as required.

2. The sequence of cleaning actions and materials used is as follows:

a. Upon receipt the unit is sandblasted and cleaned externally prior to dissembly.

b. Remove lower motor housing cover.

c. Cleaning of the motor unit and electronic components, Step 1 thru 7.

Step 1.

Dip and agitate by hand in Formula #600. This is a porcelain, enamel and metal cleaner liquid supplied by Sanico Company, 733 Middle Street, Honolulu, HI. Continue to dip and agitate for 15 to 30 seconds dependent upon corrosion buildup. Inspect frequently and when satisfied that no more corrosion can be removed flush with cold tap water. Note: The preceding solution and those that follow are all used at ambient room temperature.

Step 2.

Aqua blast using an air gun, siphon combination. A mixture of water and Liquabrasive Powder manufactured by Wheelabrator Corp., Mishawaka, Indiana is used as the blasting material. This will remove foreign dirt, rust and corrosion that could not be removed in the previous step. After blasting flush with cold tap water.

Step 3.

Dip and agitate until clean, your judgement, with solution W.O. No. 1, which is a mild acid cleaning liquid manufactured by Turco Products Inc., 6135 South Central Avenue, Los Angeles, CA. After cleaning, not more than thirty seconds, flush with cold tap water.

MATCHING UNIT, MX-6707, CLEANING PROCEDURE (CONT'D)

Step 4.

Dip in sodium bicarbonate/water solution to neutralize any acid that is present then flush with cold tap water.

Step 5.

Dip, for a few seconds, in the ammonium hydroxide, a weak alkali, solution for metal brightening and flush with cold tap water. The solution mixture instruction is attached.

Step 6.

Spray electronic components with Sanico RCT-Safety Solvent and Fast Cleaner, manufactured by Sanico Company, 733 Middle Street, Honolulu, HI. This solution is advertised to be nonconductive, noncorrosive and dries film free. Also said and labled as to remove dirt, grease, oils, wax and gum materials.

Step 7.

Place unit in oven at 130 degrees fahrenheit for approximately three hours until thoroughly dry.

DIRECTIONS TO MIX THE STEP 5 SOLUTION

Contents:

15 fl. oz. Ammonium Hydroxide, NSN 6810-00-243-4436

4 fl. oz. Acetone, NSN 6810-00-264-8955

4 fl. oz. Oleic Acid U.S.P., NSN 6810-00-285-1327 or Local Purchase from Mallinckrodt Inc., St. Louis, MO 63147

15 fl. oz. Distilled water, made locally

Mixing:

Mix acetone and oleic acid together
ADD AMMONIUM HYDROXIDE
Add the distilled water

Place in one gallon container and mix thoroughly

Add distilled water to make a full gallon

Use:

Use only small amounts and when liquid becomes milky/cloudy then discard.

Use at room temperature

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